RESEARCH MEMORANDUM

EFFECTS OF CHORD-EXTENSION AND DROOP OF COMBINED LEADING-EDGE FLAP AND CHORD-EXTENSION ON LOW-SPEED STATIC LONGITUDINAL STABILITY CHARACTERISTICS OF AN AIRPLANE MODEL HAVING A 35° SWEPTBACK WING WITH PLAIN FLAPS NEUTRAL OR DEFLECTED

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NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

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EFFECTS OF CHORD-EXTENSION AND DROOP OF COMBINED LEADING-EDGE FLAP AND CHORD-EXTENSION ON LOW-SPEED STATIC LONGITUDINAL STABILITY CHARACTERISTICS OF AN AIRPLANE MODEL HAVING A 35° SWEPTBACK WING WITH PLAIN FLAPS NEUTRAL OR DEFLECTED

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SUMMARY

A low-speed investigation was made in the Langley stability tunnel to determine the effects of a chord-extension and droop of the combined leading-edge flap and chord-extension on the static longitudinal stability characteristics of an airplane model having a 35° sweptback wing with plain trailing-edge flaps neutral or deflected. The chord-extension was of constant chord and extended from 0.68 semispan to the wing tip. In addition, various model arrangements were investigated with a chordwise fence installed at 0.36 semispan from the plane of symmetry.

With the plain flaps neutral or deflected, the chord-extension provided neutral stability at angles of attack where the plain arrangement was unstable and the droop of the combined leading-edge flap and chord-extension caused a decrease in stability and in some cases instability as well as an increase in lift-drag ratios at angles of attack from about 6° to 16°.

A comparison of the drooped leading-edge flap and chord-extension combination with a slat arrangement previously investigated on the same model indicated that at angles of attack from 11° to 26°, with flaps neutral or deflected, the slat arrangement produced considerably higher lift coefficients and lift-drag ratios than the drooped leading-edge flap and chord-extension combination. With the flaps deflected the model with the slat arrangement had a slight amount of instability at lift coefficients above 1.2 whereas the model with the drooped leading-edge and chord-extension combination was stable for all lift coefficients although the pitching moment showed a large negative increase above an angle of attack of about 10°.

The addition of the fence generally had little effect on the lift, drag, or pitching-moment characteristics of the model. The fence did, however, slightly reduce the instability caused by droop of the combined leading-edge flap and chord-extension at lift coefficients of about 0.8 with the plain flaps neutral.

INTRODUCTION

A number of recent investigations have been conducted to determine the influence of chord-extensions and chordwise fences in eliminating the longitudinal instability of swept wings and swept-wing airplanes (refs. 1 to 5). In the investigation of reference 3 the instability of a 40° sweptback-wing airplane model with flaps neutral or deflected was attributable to unstable characteristics of the wing and in this case a chord-extension was used to obtain satisfactory stability for the complete model by eliminating the instability of the wing. In the case of a 35° swept-wing airplane model (flaps neutral) which had longitudinal instability attributable to an unstable variation of downwash angle with angle of attack, the use of either a chord-extension or a chordwise fence reduced the longitudinal instability to neutral stability (ref. 4). The investigation of reference 5, on the same model used in reference 4, indicated that two fences were necessary to reduce the instability of the model for both the clean and landing conditions. The landing condition included the extension of leading-edge slats, landing gear, and the deflection of plain trailing-edge flaps.

The present investigation was conducted mainly to determine the effects of a chord-extension on the static longitudinal stability of this 35° sweptback-wing model with plain flaps deflected and landing gear and doors extended and to determine the effects of a drooped leading-edge flap in combination with a drooped chord-extension on the lift, drag, and static longitudinal stability characteristics of the model in the clean and landing conditions. The fence with which the airplane was originally equipped was mounted on the wing for some tests.

SYMBOLS

The data presented herein are in the form of standard NACA symbols and coefficients of forces and moments and are referred to the stability system of axes with the origin at the projection of the quarter-chord point of the mean aerodynamic chord of the wing without a chord-extension on the plane of symmetry. The positive direction of the forces, moments, and angular displacements is shown in figure 1. The coefficients which were based on the wing with chord-extension removed and symbols used herein are defined as follows:

C_L	lift coefficient, L/qS
$C_{L_{max}}$	maximum lift coefficient
C_D	drag coefficient, D/qS
C_M	pitching-moment coefficient, $M/qS\bar{c}$
L/D	lift-drag ratio
$(L/D)_{max}$	maximum lift-drag ratio
L	lift, lb
D	drag, lb
M	pitching moment, ft-lb
A	aspect ratio, b^2/S
b	wing span, ft
S	area of plain wing, sq ft
c	wing local chord parallel to plane of symmetry, ft
$\bar{c}$	wing mean aerodynamic chord, $\frac{2}{S}\int_0^{b/2} c^2 dy$, ft
q	dynamic pressure, $\frac{\rho V^2}{2}$, lb/sq ft
ρ	density of air, slugs/cu ft
V	free-stream velocity, fps
i_w	incidence of wing-root-chord line with respect to fuselage center line, deg (3° for present investigation)
α	angle of attack of fuselage center line, deg (angle of attack of wing is related to angle of attack of fuselage center line by $\alpha_w = \alpha + i_w$; see fig. 1)
δ_f	deflection of plain trailing-edge flaps, deg (measured perpendicular to hinge line)

δ_n droop angle, deg (deflection of leading-edge flap and chord-extension combination measured parallel to plane of symmetry)

y spanwise distance measured perpendicular to plane of symmetry, ft

APPARATUS, MODEL, AND TESTS

The present investigation was conducted in the 6-foot-diameter test section of the Langley stability tunnel with the model mounted at the origin of the axes system on a single support strut. The strut was attached to a six-component balance system.

The model used for the present investigation is shown in figure 2. The basic wing (chord-extension removed) had an aspect ratio of 3.57, a taper ratio of 0.565, an area of 2.975 square feet, and a mean aerodynamic chord of 0.942 foot. The wing with the chord-extension (configuration 7 of ref. 4) had an aspect ratio of 3.42, an area of 3.078 square foot, and a mean aerodynamic chord of 0.965 foot. The span of the chord-extension was 0.32 semispan and it extended from the tip inboard.

The portion of the wing leading edge from $0.432\frac{b}{2}$ to the tip (constant chord of $0.136\bar{c}$) was hinged (fig. 2) to enable several droop angles to be investigated. This span was selected to duplicate the span of the slats of model 2 of reference 5. Fence A of reference 5 was installed on the model at $0.36\frac{b}{2}$ for some tests. In addition, plain trailing-edge flaps were incorporated in the wing. All gaps caused by the drooped leading edge and plain flaps were sealed. Photographs of the model are presented in figure 3.

Force tests, consisting of the measurement of lift, drag, and pitching moment through an angle-of-attack range of -4° to 36°, were made at a dynamic pressure of 39.7 pounds per square foot. The test Mach number was 0.17 and the Reynolds number was 1.1×10^6 based on the mean aerodynamic chord of the basic wing. Although the condition of $\delta_f = 0^{\circ}$ and $\delta_n = 0^{\circ}$ was investigated in reference 4, this condition

was repeated herein to have all data under the same test conditions. The force tests are summarized in the following table:

Model arrangement	δ_f, deg	δ_n, deg	Fence A
Complete	0	0 3 6 9	Off and on
↓	50	0 3 6 9	↓
Horizontal tail off	0	0 6	↓
↓	50	0 6	↓

For the tests with the plain flaps deflected 50°, the landing gear and doors were installed on the model; whereas, with the flaps neutral, the gear and doors were removed. The horizontal tail incidence was 0°.

CORRECTIONS

Approximate jet-boundary corrections, based on unswept-wing concepts, have been applied to the angle of attack and drag coefficient. The methods of reference 6, also for unswept wings, were used to determine blockage corrections which were applied to the drag coefficient and dynamic pressure. Jet-boundary corrections were applied to horizontal-tail-on pitching moments and were determined by the methods of reference 7.

Support strut tares have not been applied to the data but, with the exception of the drag tare, are believed to be small. The absolute values of the drag coefficient and L/D are not believed representative of free-air conditions; however, the increments due to the plain flaps, droop, and fence A are believed to be reliable.

RESULTS AND DISCUSSION

General Remarks

Inasmuch as a detailed discussion of the effects of the chord-extension on the lift and pitching-moment characteristics of the model with plain flaps neutral was presented in reference 4, only brief consideration will be given herein. The chord-extension of configuration 7 of reference 4 was selected for the present investigation because it was found to be satisfactory from the standpoint of longitudinal stability up to Mach numbers of 0.94 in tests in the Langley high-speed 7- by 10-foot tunnel (data unpublished).

In figures 4 to 11 the pitching-moment data are plotted against angle of attack as are C_L, L/D, and C_D. Since the present investigation is concerned primarily with longitudinal stability, the pitching-moment data are also plotted against lift coefficient for the various model arrangements in figures 12 and 13. In all cases where the plain flaps were deflected, the landing gear and doors were installed on the model.

Effects of Chord-Extension

With the plain trailing-edge flaps neutral (fig. 12(a)) the addition of a chord-extension to the basic model reduced the instability which occurred around $C_L = 0.7$ to neutral stability. With the plain flaps deflected 50° the instability of the basic model which occurred at about $C_L = 0.9$ was eliminated by the addition of the chord-extension (fig. 12(b)).

Deflecting the plain flaps produced a large, approximately constant, increment in C_L up to about $\alpha = 9^\circ$ with either the chord-extension off or on. Addition of the chord-extension with flaps neutral or deflected increased the lift coefficient at high lift coefficients. (See figs. 4(a) and 5(a).) Although the chord-extension produced a higher lift coefficient than the basic model from about $\alpha = 8^\circ$ to $\alpha = 26^\circ$, the increment in lift coefficient due to flap deflection was about one-half that of the basic model for angles of attack between 14° and 24°. The chord-extension arrangement with $\delta_f = 0^\circ$ had a higher lift coefficient at angles of attack between 14° and 24° than did the basic model with $\delta_f = 50^\circ$. The effects of the chord-extension with flaps neutral on the variation of L/D and C_D with α are similar to those with the flaps deflected. Deflection of the flaps 50° decreased $(L/D)_{max}$ by about a factor of 1.5. (Compare figs. 4(c) and 5(c).) The chord-extension increased L/D from angles of attack of about 6° to 20° (fig. 5(c)).

The addition of fence A to the chord-extension arrangement had essentially no effect on C_m, C_L, L/D, or C_D with flaps neutral or deflected. (See figs. 4, 5, and 12.) The fence had no appreciable effect on the stability of the model with the chord-extension off as was noted in reference 5.

Effects of Droop of Combined Leading-Edge Flap and Chord-Extension

Plain flaps neutral.- Deflecting the combined leading-edge flap and chord-extension outboard of $0.432\frac{b}{2}$ ($\delta_n = 3^\circ, 6^\circ, 9^\circ$) caused instability of the model in the angle-of-attack range of about 9° to 14° whereas only insignificant changes occurred in stability at all other angles of attack investigated (fig. 6(a)). A similar result was noted in reference 3. For all droop angles investigated the model was stable up to $C_L = 0.8$ ($\alpha = 9^\circ$). (See fig. 13(a).)

Although tuft studies or wake surveys were not made for the present investigation, the unstable effects of the separation vortex (ref. 4) were believed to be increased by a vortex along the outboard edge of the undrooped part of the leading edge which increased as the droop angle increased. This is similar to the vortex along the inboard face of the chord recession investigated in reference 4. The beneficial vortex along the inboard face of the drooped leading-edge flap is possibly masked by the vortex on the undrooped section. Droop produced noticeable changes in C_L only for angles of attack greater than about 20° (fig. 6(a)).

The largest effects of droop of the combined leading-edge flap and chord-extension on L/D were in the angle-of-attack range of $\alpha = 6^\circ$ to $\alpha = 16^\circ$ where an increase in droop increased L/D (fig. 6(c)) which resulted from a decrease in C_D.

With the horizontal tail removed, 6° of droop of the combined leading-edge flap and chord-extension did not produce significant changes in stability (fig. 7(a)). The variation of C_m with C_L for $\delta_n = 0$ or $\delta_n = 6^\circ$ is satisfactory up to about $C_L = 1.0$ (fig. 13(a)). The effects of droop on the drag and L/D with the horizontal tail removed (fig. 7(c)) are somewhat similar to those with the tail on (fig. 6(c)).

The addition of fence A slightly decreased the instability caused by droop of the combined leading-edge flap and chord-extension at lift coefficients of about 0.8 (figs. 13(a) and 13(b)). The fence had insignificant effects on L/D and C_D (fig. 6).

Plain flaps deflected.- The model with the plain flaps deflected 50° is stable or neutrally stable throughout the angle-of-attack range for droop angles of 0°, 3°, and 6°. The 9° droop caused instability at

about $\alpha = 11^\circ$ (fig. 8(a)). With the flaps deflected the variation of C_m with C_L is about constant up to $C_L = 1.0$ for all droop angles (fig. 13(c)). The effects of droop on L/D and C_D with the flaps deflected (figs. 8(c) and 8(d)) are similar to those with the flaps neutral (figs. 6(c) and 6(d)). Droop of the combined leading-edge flap and chord-extension produced no significant changes in the stability of the model with the horizontal tail off (figs. 9(a) and 13(c)) and plain flaps deflected as was the case with the flaps neutral.

With fence A on the wing, the model was stable or neutrally stable through the angle-of-attack range only for droop angles of 0° and 3° (fig. 8(b)), instability occurring with 6° and 9° droop at about $\alpha = 11^\circ$.

Comparison With Slat Arrangement

A comparison of the characteristics of the model equipped with 6° of droop of the combined leading-edge flap and chord-extension with the various slat and flap arrangements investigated in reference 5 is made in figures 10 to 12. This amount of droop was chosen because with flaps deflected and fence A off neutral or positive stability was maintained throughout the angle-of-attack range investigated (fig. 8(a)). The slat deflection used in the investigation of reference 5 was 14.5° measured parallel to the plane of symmetry.

Plain flaps neutral.- With the plain flaps neutral (fig. 10(a)) the model with either the leading-edge flap and chord-extension combination drooped 6° or slat extended was stable up to about 10.5° which corresponds to a lift coefficient of about 0.8. The variation of C_m with C_L (fig. 12(c)) was about the same for both arrangements up to $C_L = 0.8$. The drooped leading-edge flap and chord-extension combination was more unstable, but for a shorter range of lift coefficients ($C_L = 0.8$ to 0.9), than the slat arrangement which was unstable from $C_L = 0.8$ to 1.02. The drooped leading-edge flap and chord-extension combination was stable at higher lift coefficients whereas the slat arrangement was unstable at about $C_L = 1.2$. The slat arrangement produced a higher lift coefficient than the drooped leading-edge flap and chord-extension combination from about $\alpha = 10^\circ$ to $\alpha = 26^\circ$ (fig. 10(a)). There was essentially no difference in lift coefficient between the two model arrangements for other angles of attack. Each model arrangement had about the same $(L/D)_{max}$ (fig. 10(c)) which was only slightly affected by the addition of fence A (fig. 10(d)) whereas in the angle-of-attack range from $\alpha = 11^\circ$ to $\alpha = 26^\circ$ the slat arrangement produced a higher value of L/D than the drooped leading-edge flap and chord-extension combination.

Addition of fence A to either arrangement improved the stability around $C_L = 0.8$. The slat arrangement was improved to about neutral

stability but the drooped leading-edge flap and chord-extension combination still was unstable (figs. 10(b) and 12(c)).

Plain flaps deflected.- With the plain flaps deflected 50° (figs. 11(a) and 12(d)) the drooped leading-edge flap and chord-extension combination was stable throughout the lift-coefficient range investigated although the variation of C_m with C_L showed a large negative increase above $\alpha = 10^\circ$. The slat arrangement was stable up to about $C_L = 1.2$, after which slight instability occurred. The slat arrangement produced much higher lift coefficients than the drooped leading-edge flap and chord-extension combination between angles of attack of about 10° and 24° (fig. 11(a)). As in the case of the flaps neutral, with the flaps deflected 50° the slat arrangement produced the highest values of L/D for angles of attack from 8° to 24° (fig. 11(c)) and the addition of fence A did not produce significant changes in L/D or C_D (fig. 11(d)).

Addition of fence A to the drooped leading-edge flap and chord-extension combination had very little effect on the stability but the fence did slightly improve the stability of the slat arrangement (fig. 12(d)). The fence had little or no effect on the lift coefficient for the drooped leading-edge flap and chord-extension combination whereas with the slat arrangement a reduction in C_L was caused by the fence at angles of attack from 13° to 19°.

CONCLUSIONS

A low-speed investigation made in the Langley stability tunnel to determine the effects of a chord-extension and droop of the combined leading-edge flap and chord-extension on the static longitudinal characteristics of an airplane model having a 35° sweptback wing with plain flaps neutral or deflected has indicated the following conclusions:

1. With flaps neutral or deflected the chord-extension, extending from 0.68 semispan to the wing tip, provided stability or neutral stability at all angles of attack investigated. The basic model showed some instability.

2. Drooping the leading-edge flap and chord-extension combination caused a decrease in stability and in some cases instability, with the flaps neutral or deflected.

3. Drooping the leading-edge flap and chord-extension combination increased the lift-drag ratio at angles of attack from about 6° to 16°, with flaps neutral or deflected.

4. A comparison of the drooped leading-edge flap and chord-extension combination with a slat arrangement previously investigated on the same model indicated that at angles of attack from 11° to 26° with flaps neutral or deflected, the slat arrangement produced considerably higher lift coefficients and lift-drag ratios than the drooped leading-edge flap and chord-extension combination.

5. With the flaps deflected the slat arrangement had a slight amount of instability at lift coefficients above 1.2 whereas the drooped leading-edge flap and chord-extension combination was stable for all lift coefficients although the pitching-moment coefficient showed a large negative increase above an angle of attack of about 10°.

6. The addition of a fence to the model at 0.36 semispan from the plane of symmetry generally had little effect on pitching-moment coefficients, lift coefficients, lift-drag ratios, or drag coefficients. The fence did, however, slightly reduce the instability caused by droop of the combined leading-edge flap and chord-extension at lift coefficients of about 0.8 with the plain flaps neutral.

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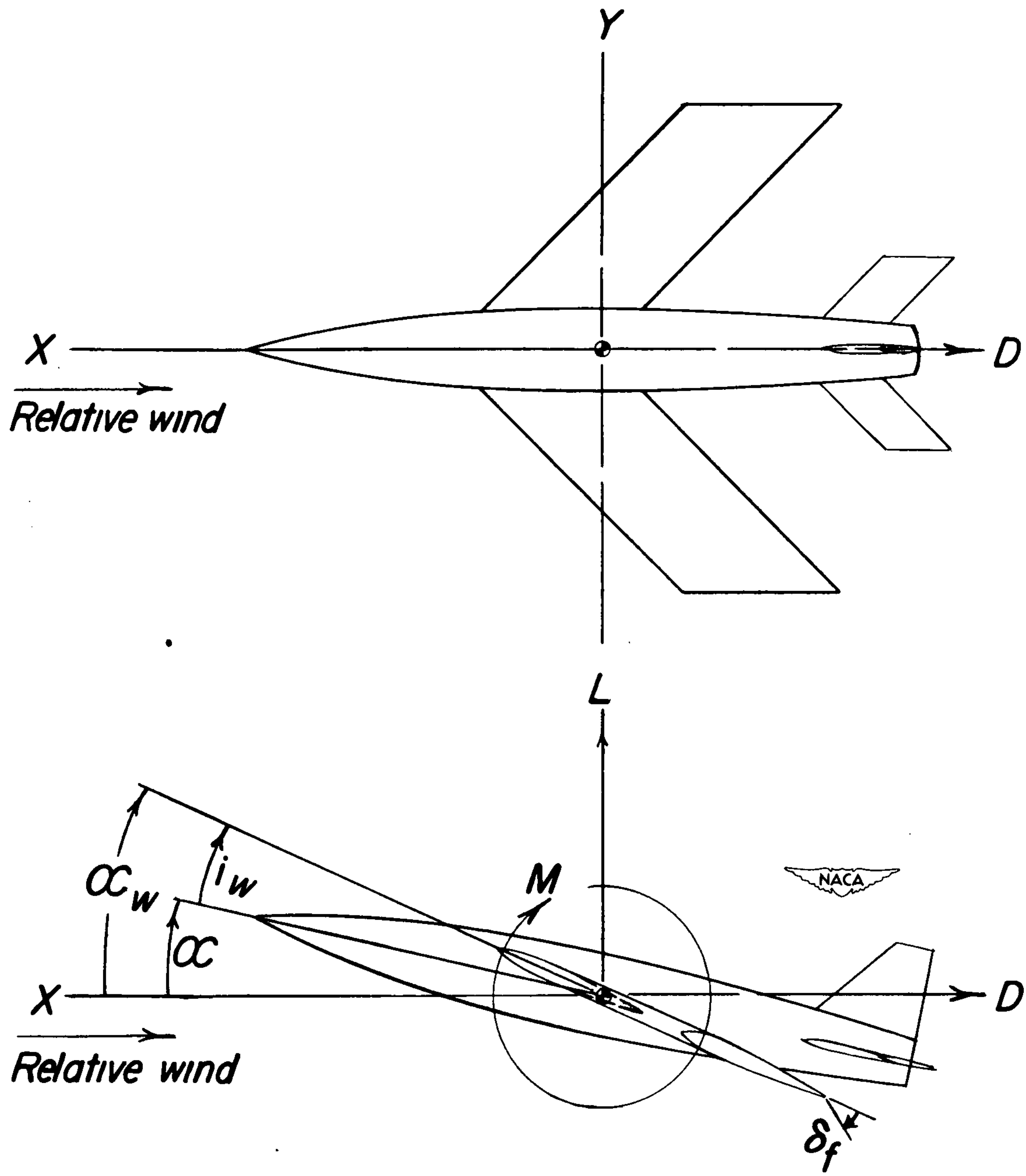
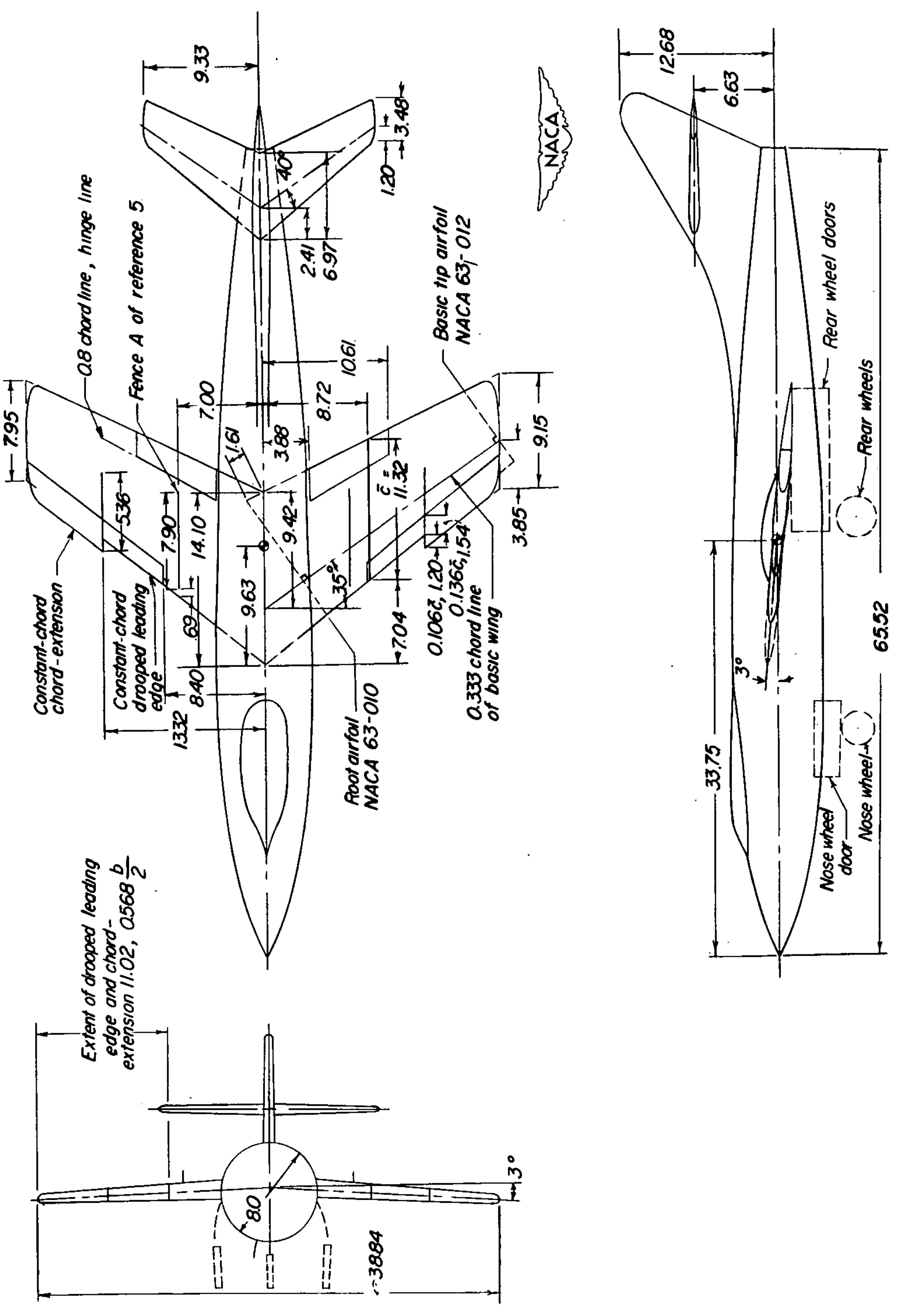
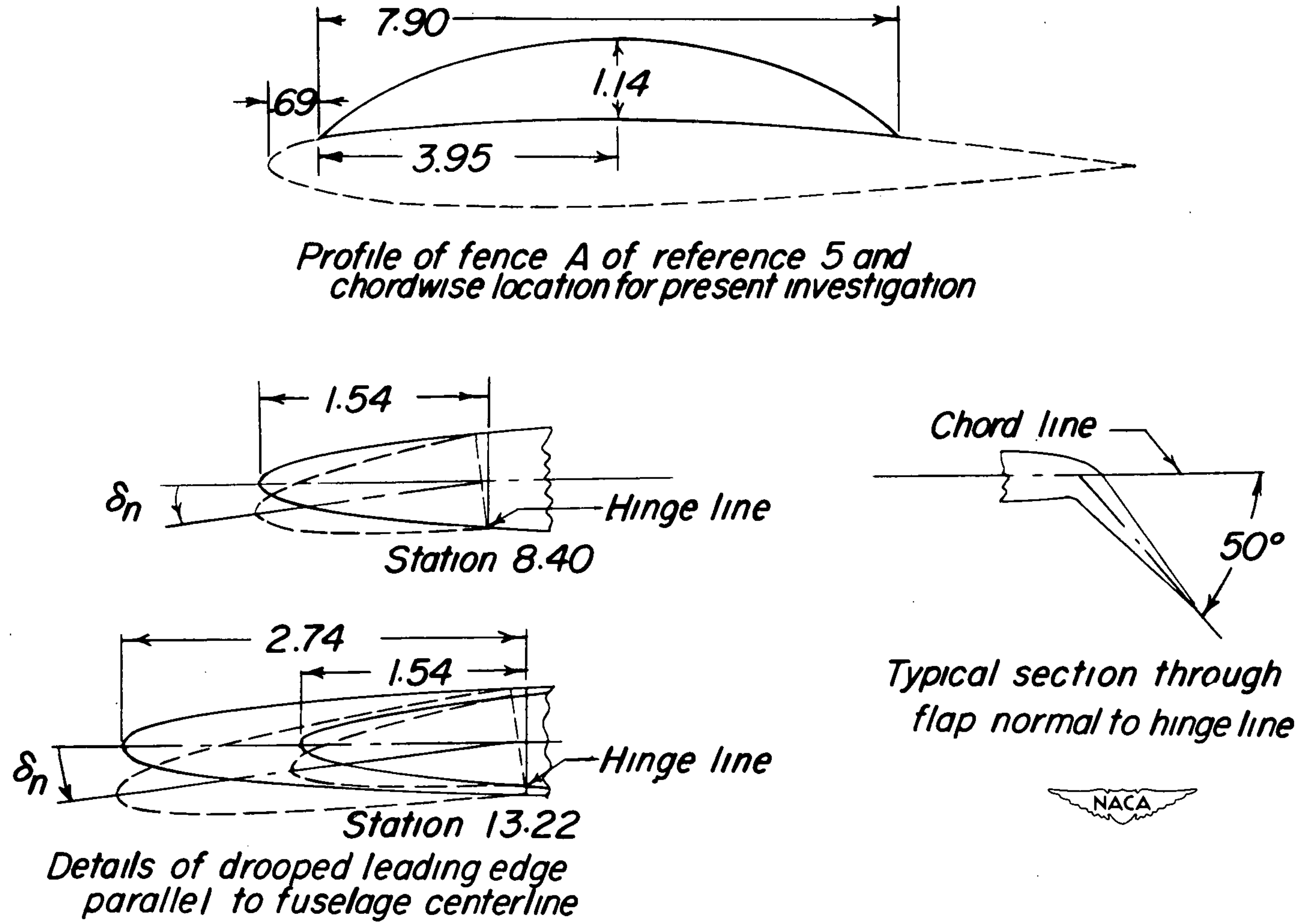


Figure 1.- Stability system of axes. Arrows indicate positive direction of forces, moments, and angular displacements.



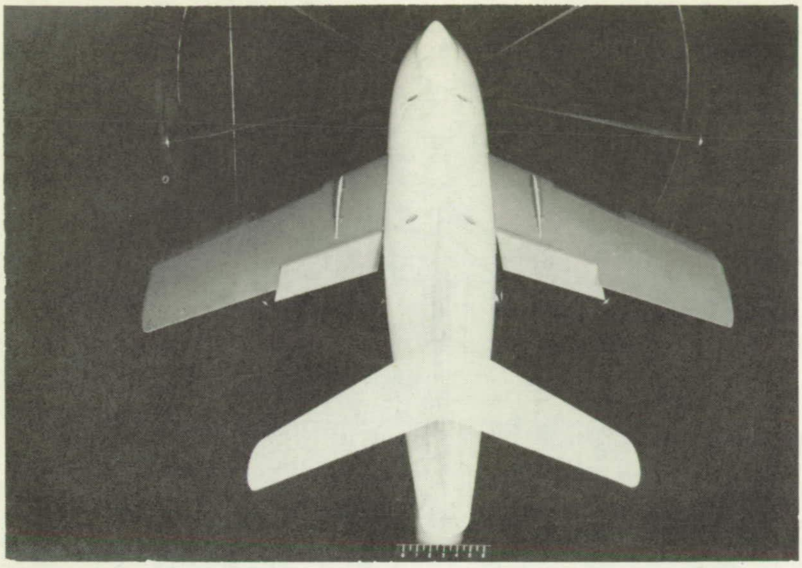
(a) General model arrangement.

Figure 2.- Pertinent model dimensions. All dimensions are in inches.

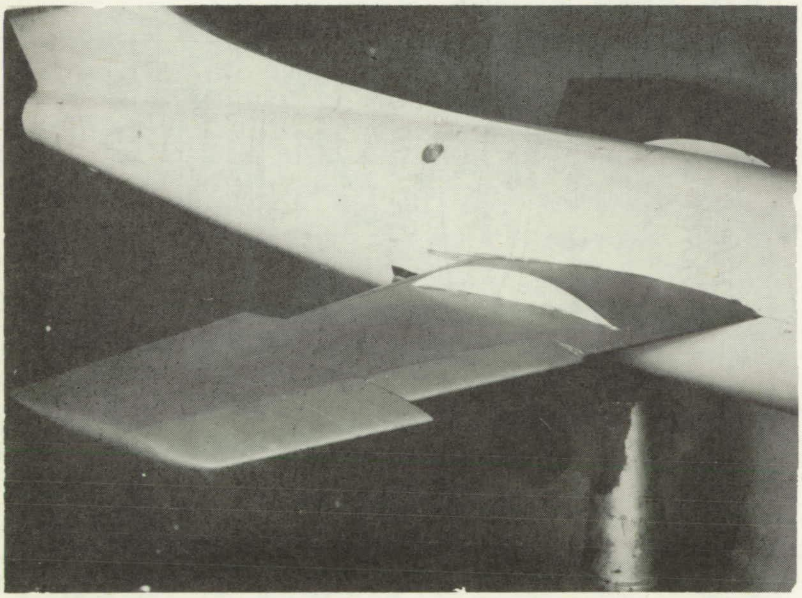


(b) Details of fence A, drooped leading-edge, and plain flap.

Figure 2.- Concluded.

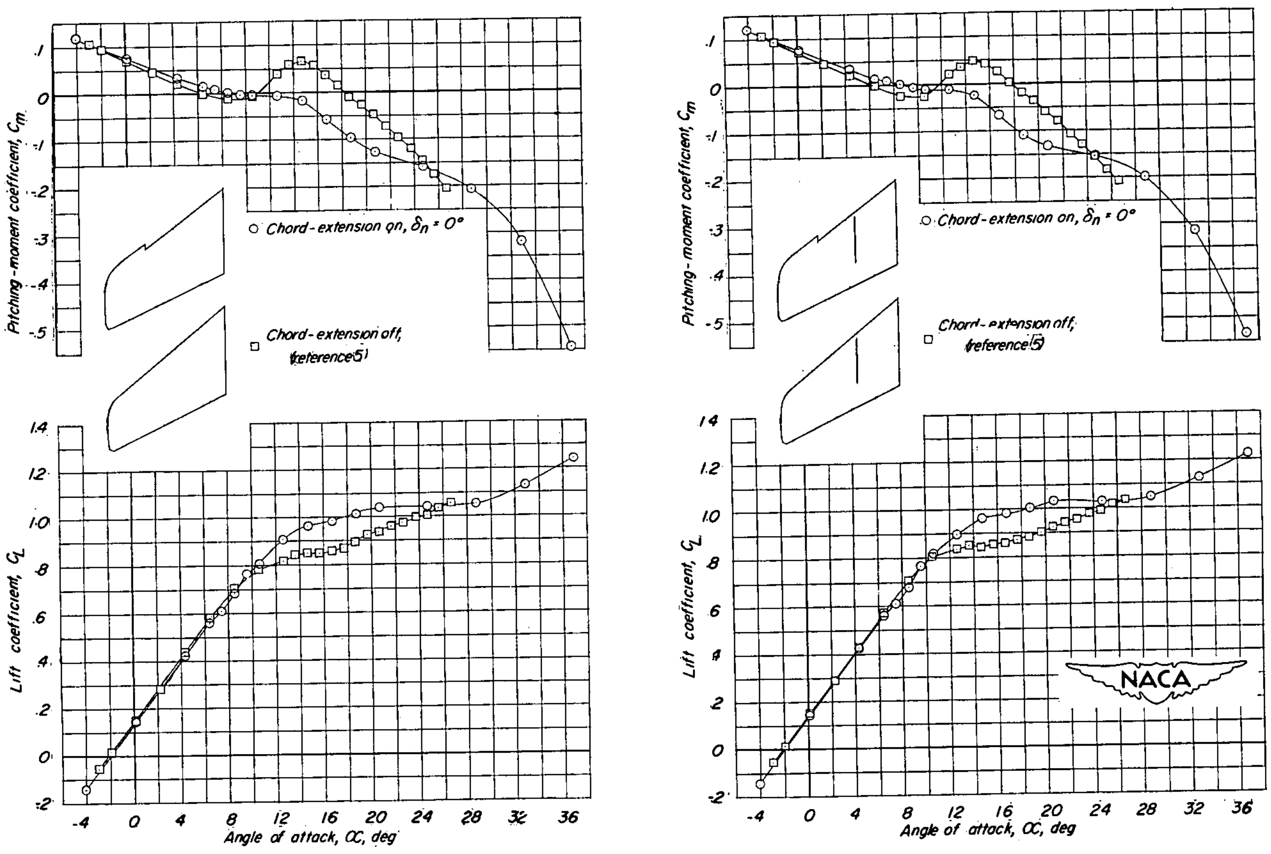


(a) Rear view. L-75325



(b) Three-quarter front view. L-75326

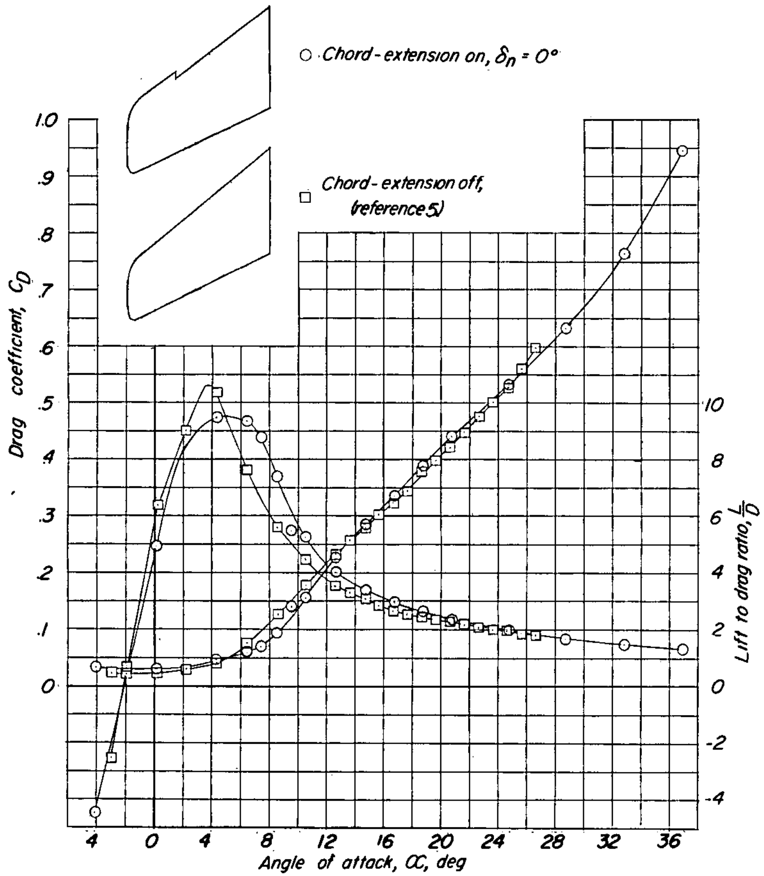
Figure 3.- Model mounted in Langley stability tunnel. $\delta_n = 9^{\circ}$; $\delta_f = 50^{\circ}$; fence A on.



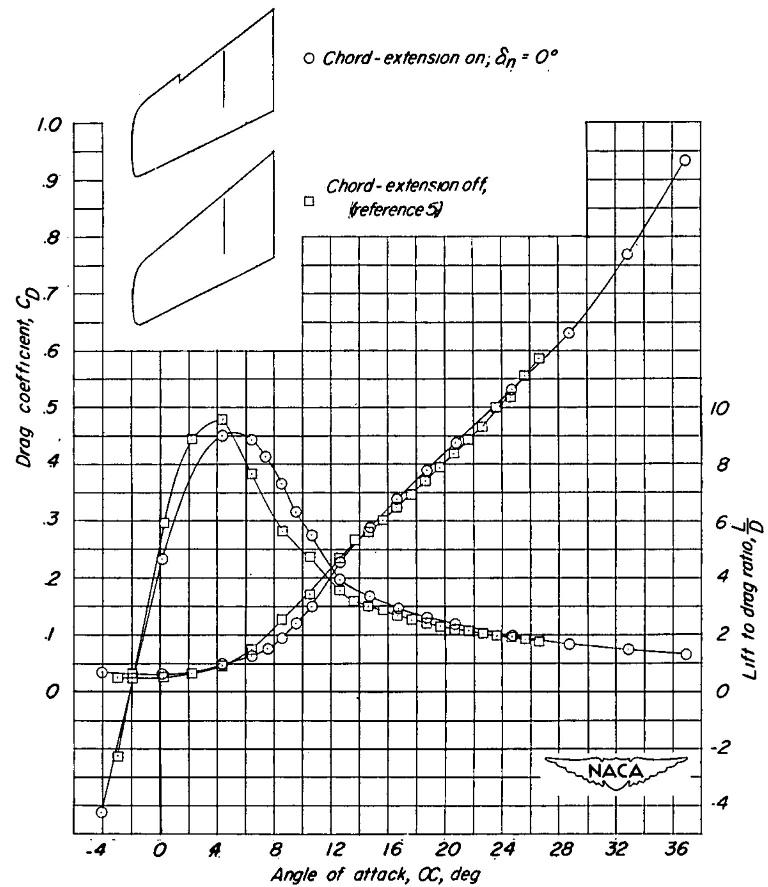
(a) Variation of C_m and C_L with α. Fence A off.

(b) Variation of C_m and C_L with α. Fence A on.

Figure 4.- Effect of chord-extension on aerodynamic characteristics of an airplane model having a 35° sweptback wing. Complete model; $\delta_f = 0°$.

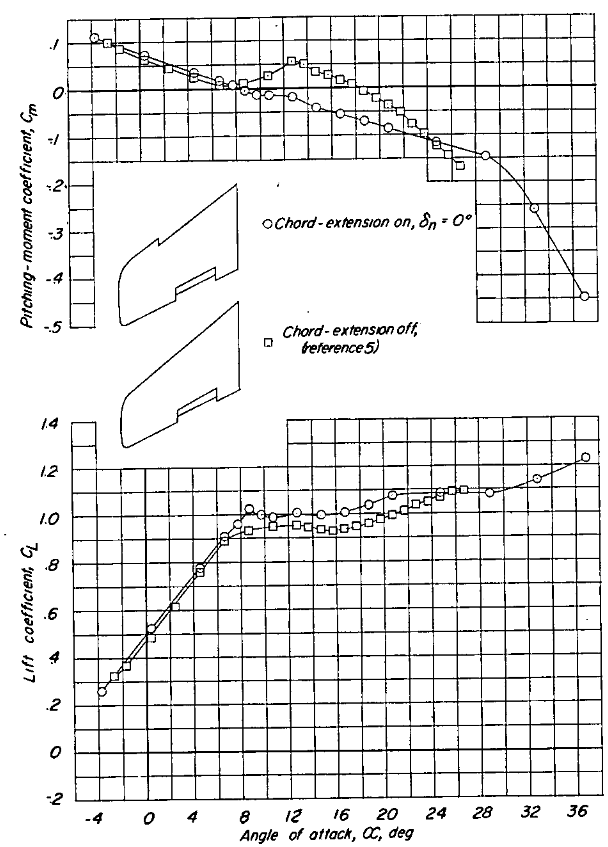


(c) Variation of C_D and L/D with α. Fence A off.

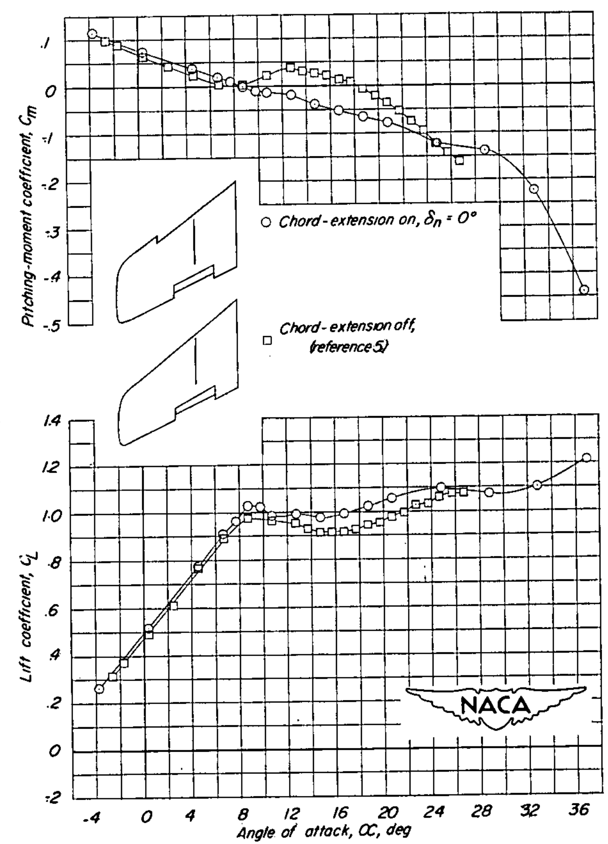


(d) Variation of C_D and L/D with α. Fence A on.

Figure 4.- Concluded.

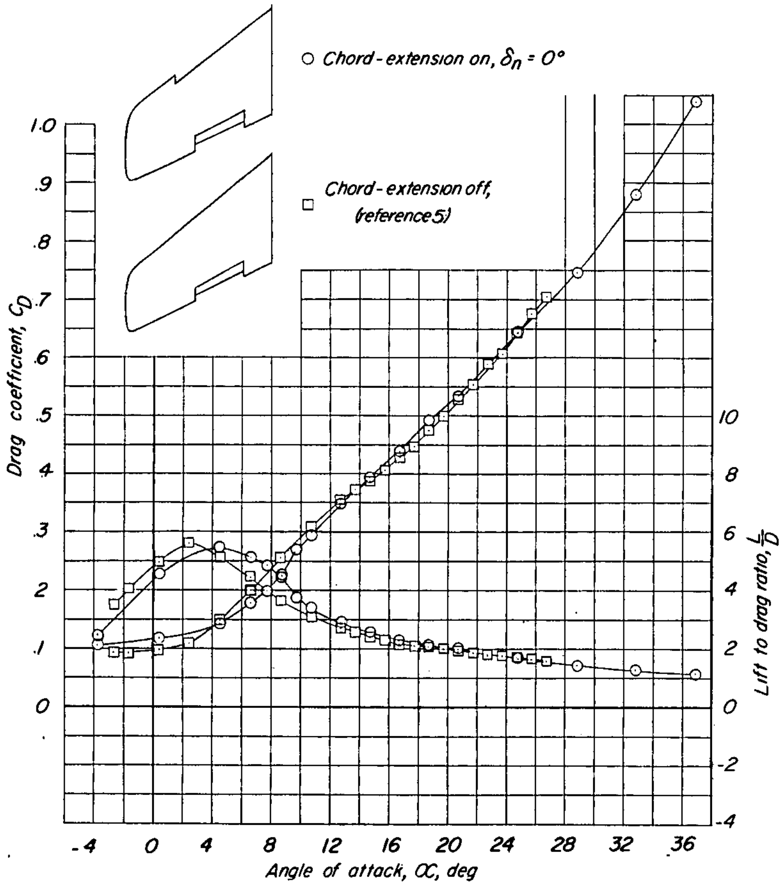


(a) Variation of C_m and C_L with α. Fence A off.

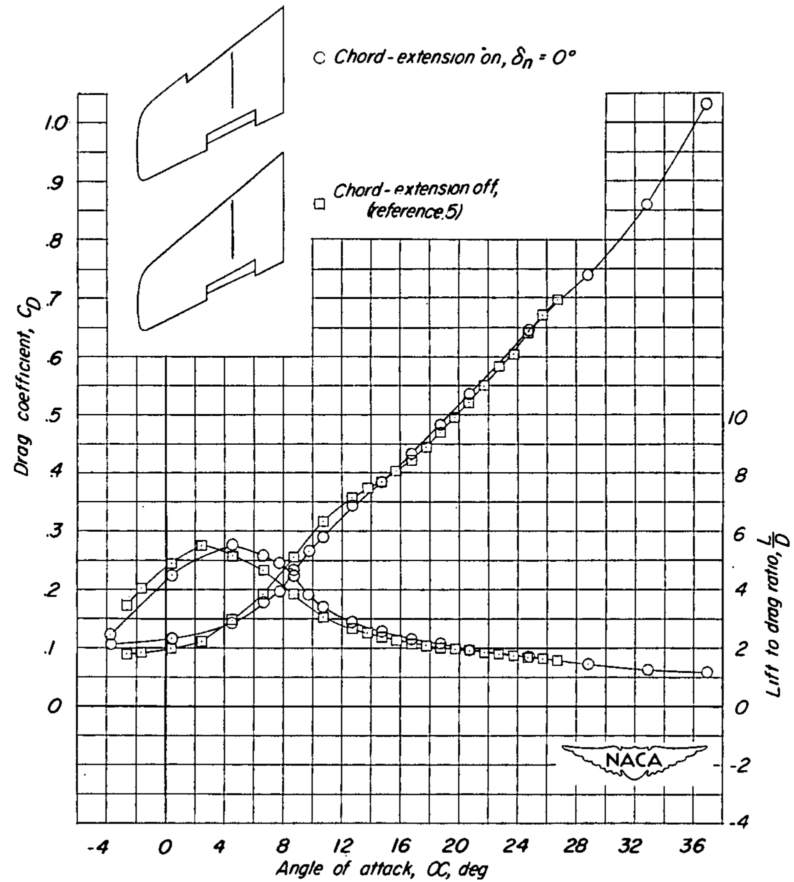


(b) Variation of C_m and C_L with α. Fence A on.

Figure 5.- Effect of chord-extension on aerodynamic characteristics of an airplane model having a 35° sweptback wing. Complete model; $\delta_f = 50°$.

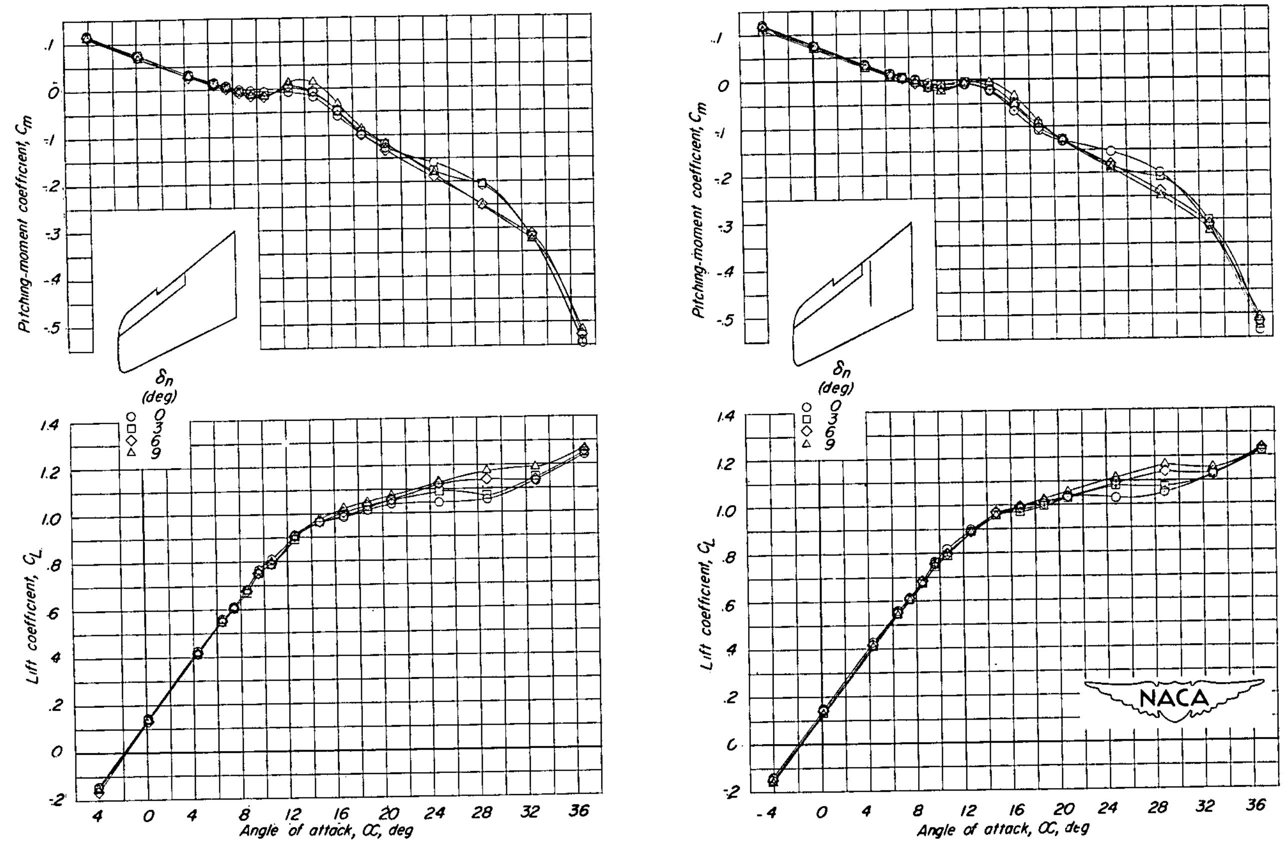


(c) Variation of C_D and L/D with α. Fence A off.



(d) Variation of C_D and L/D with α. Fence A on.

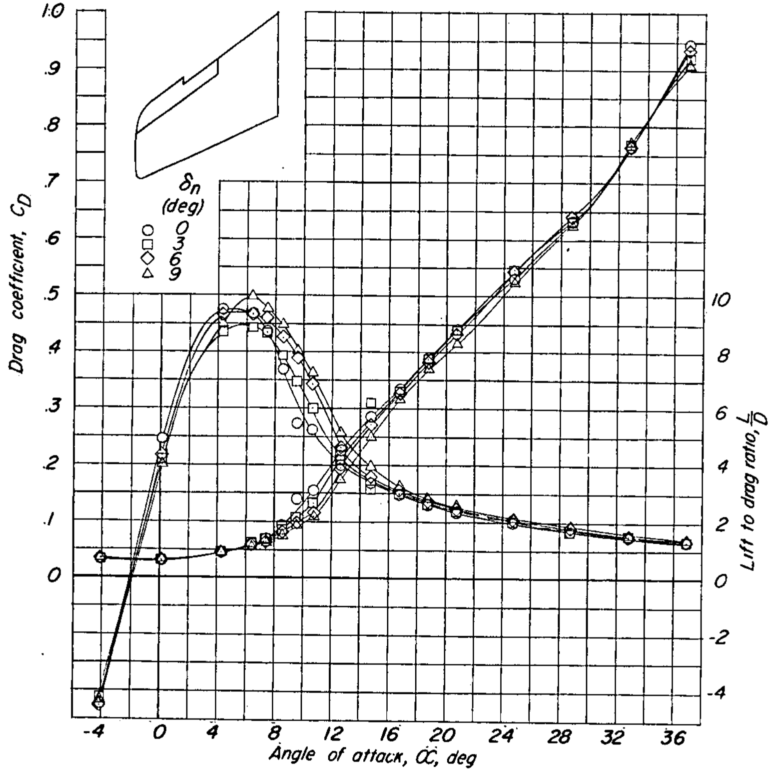
Figure 5.- Concluded.



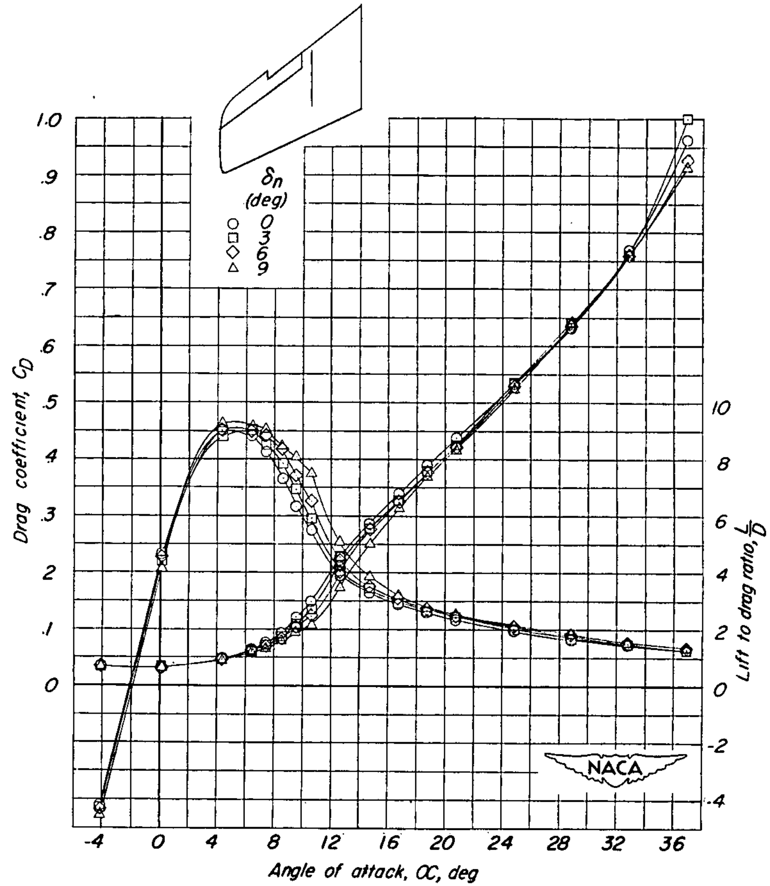
(a) Variation of C_m and C_L with α. Fence A off.

(b) Variation of C_m and C_L with α. Fence A on.

Figure 6.- Effect of droop of combined leading-edge flap and chord-extension on aerodynamic characteristics of an airplane model having a 35° swept-back wing. Complete model; $\delta_f = 0^{\circ}$.

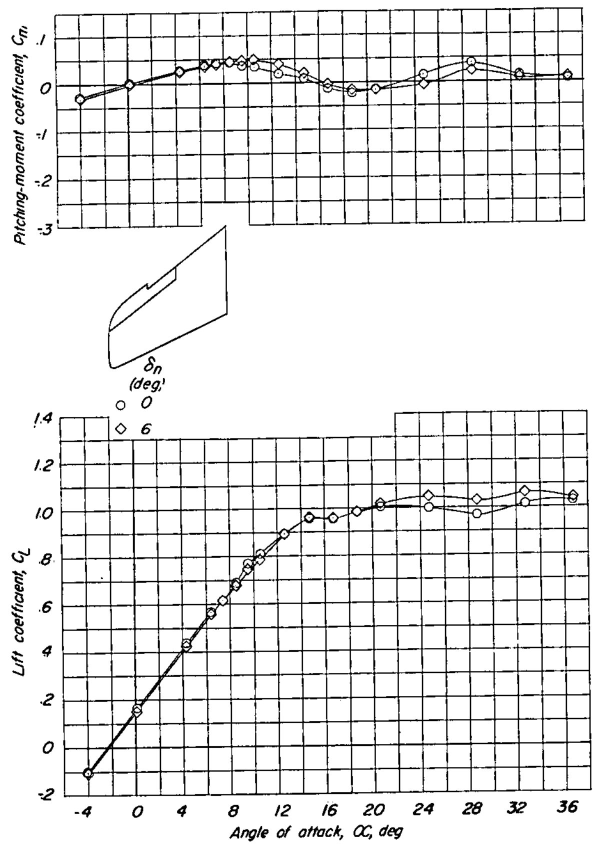


(c) Variation of C_D and L/D with α.
Fence A off.

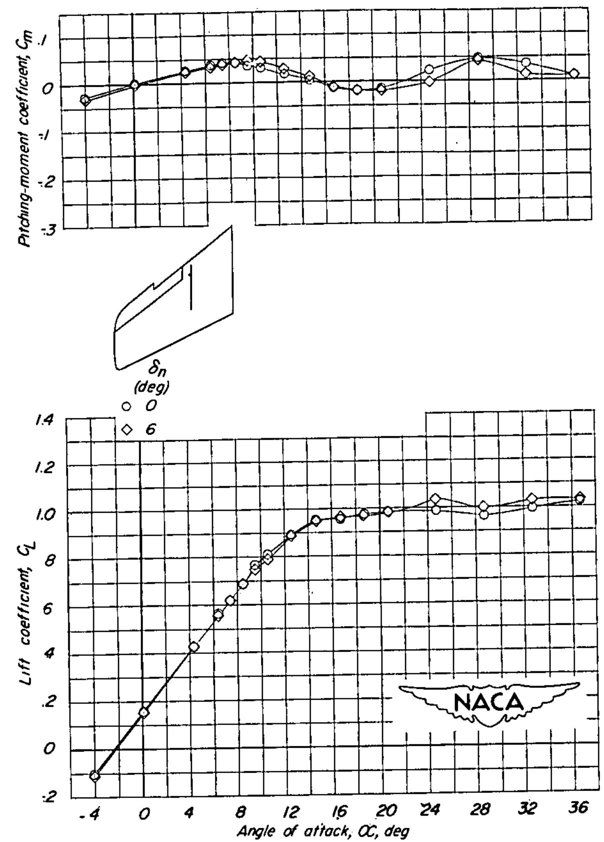


(d) Variation of C_D and L/D with α.
Fence A on.

Figure 6.- Concluded.

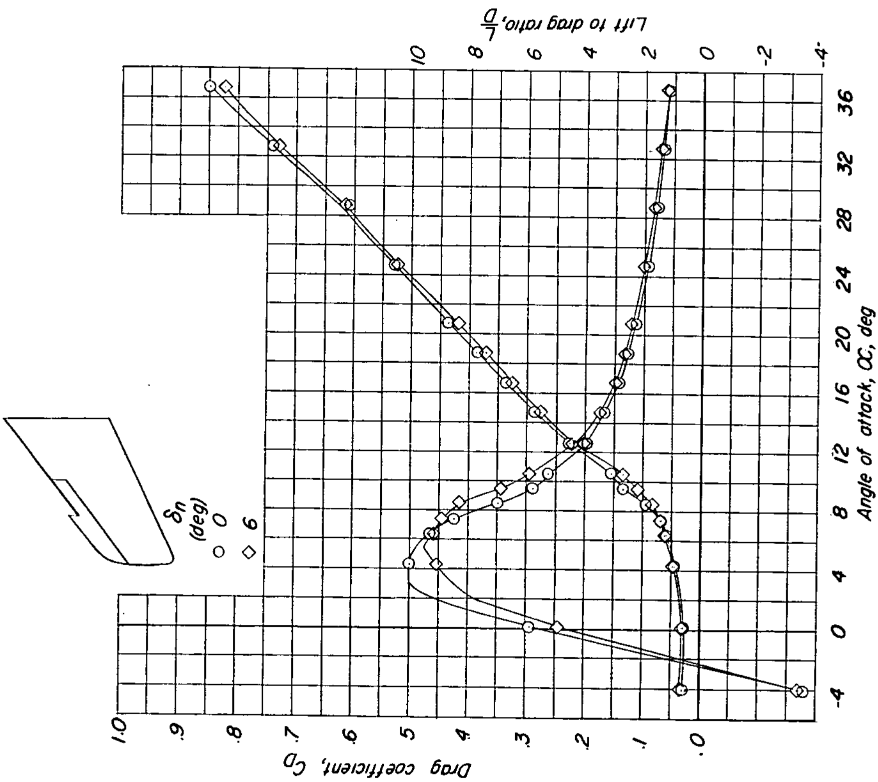


(a) Variation of C_m and C_L with α. Fence A off.

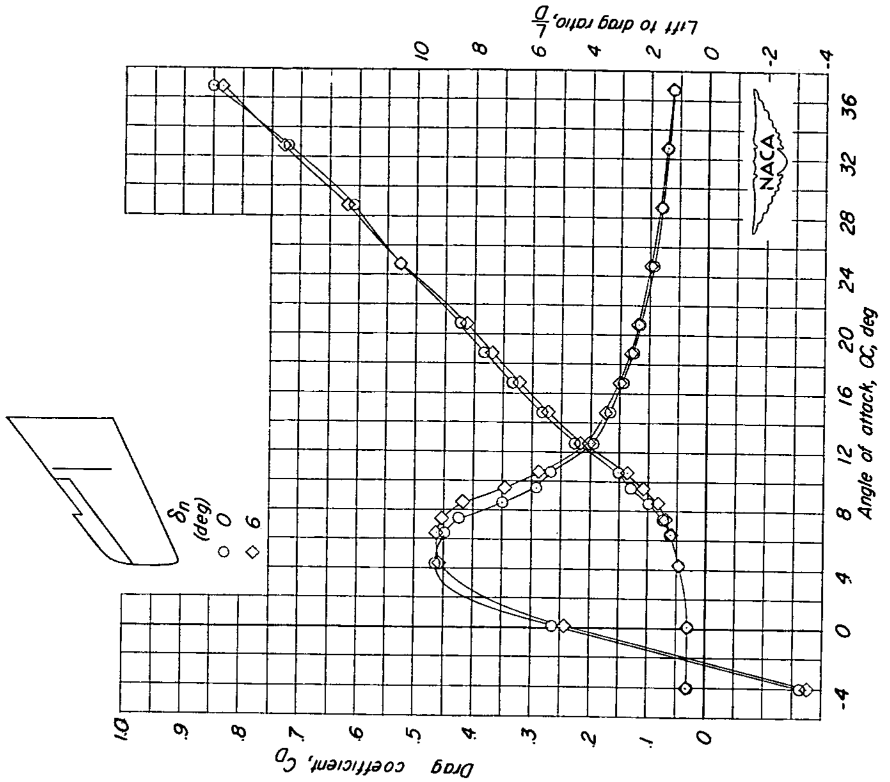


(b) Variation of C_m and C_L with α. Fence A on.

Figure 7.- Effects of droop of combined leading-edge flap and chord-extension on aerodynamic characteristics of an airplane model having a 35° swept-back wing. Horizontal tail off; $\delta_f = 0°$.

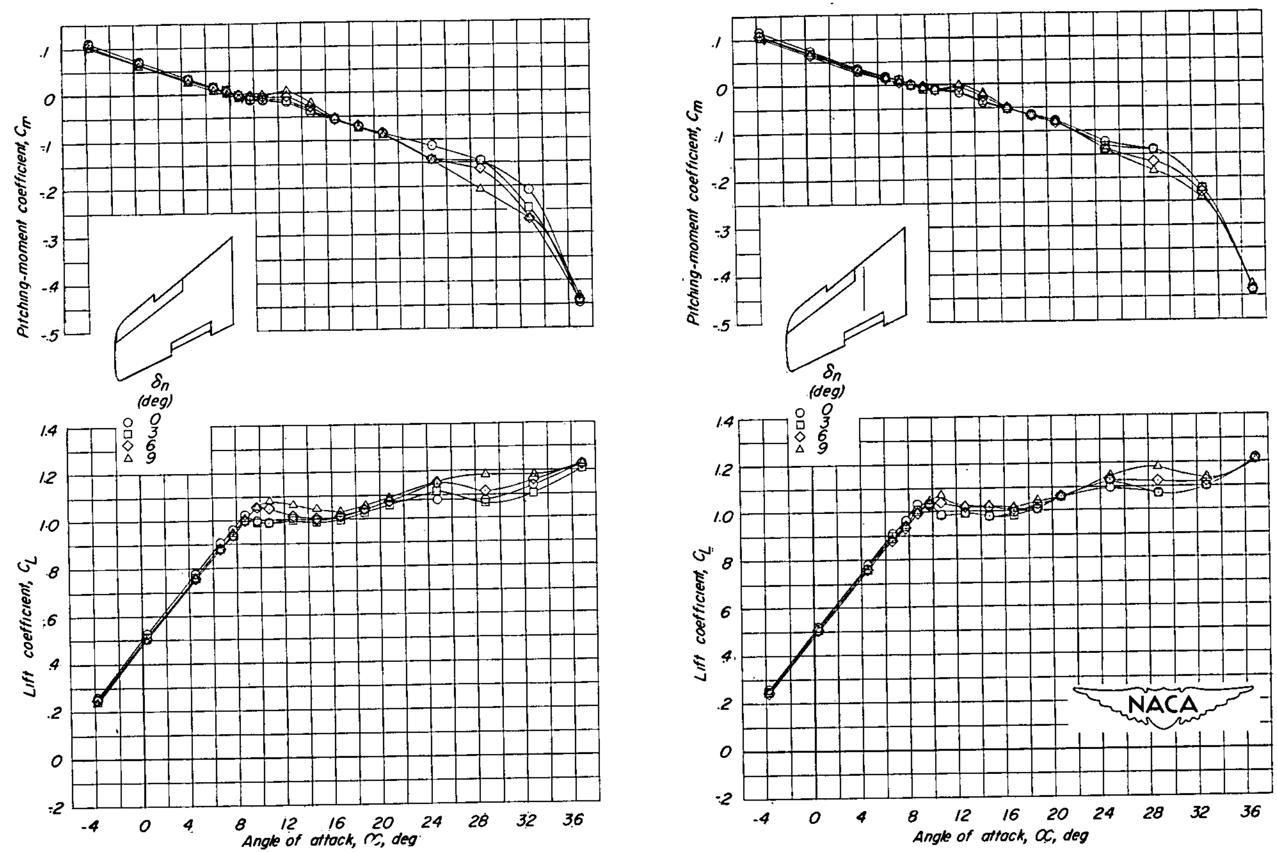


(c) Variation of C_D and L/D with α. Fence A off.



(d) Variation of C_D and L/D with α. Fence A on.

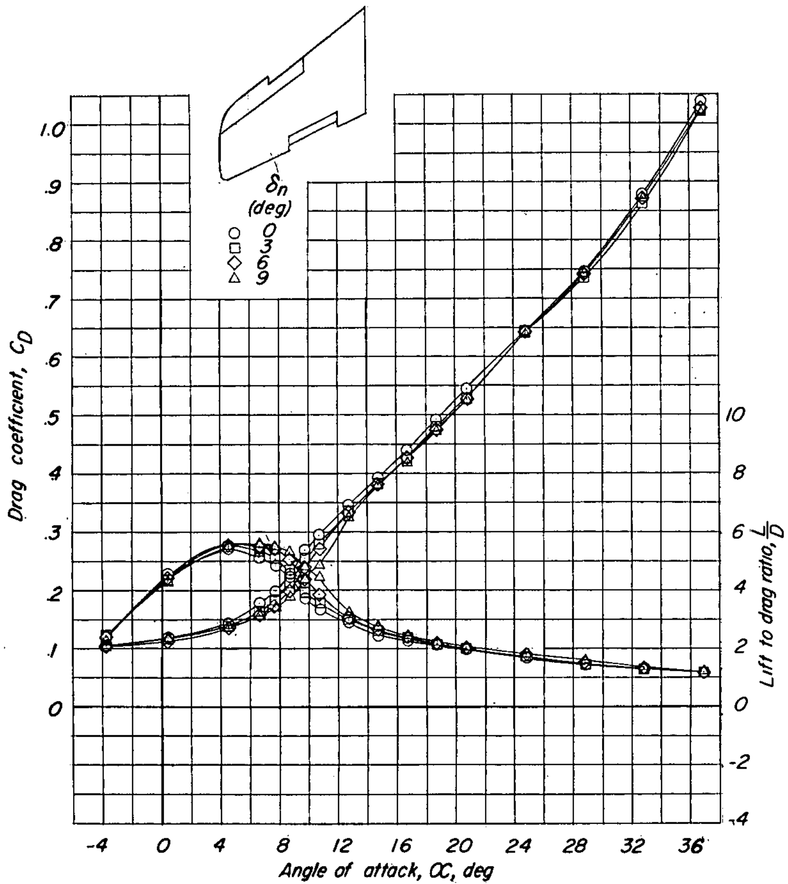
Figure 7.- Concluded.



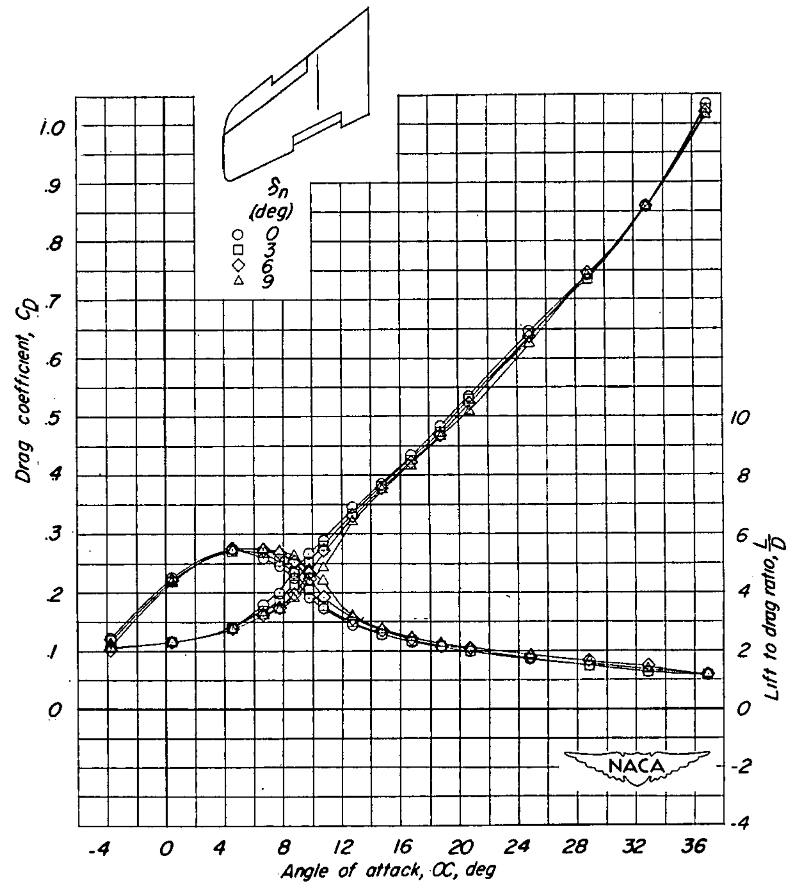
(a) Variation of C_m and C_L with α. Fence A off.

(b) Variation of C_m and C_L with α. Fence A on.

Figure 8.- Effect of droop of combined leading-edge flap and chord-extension on aerodynamic characteristics of an airplane model having a 35° swept-back wing. Complete model; $\delta_f = 50°$.

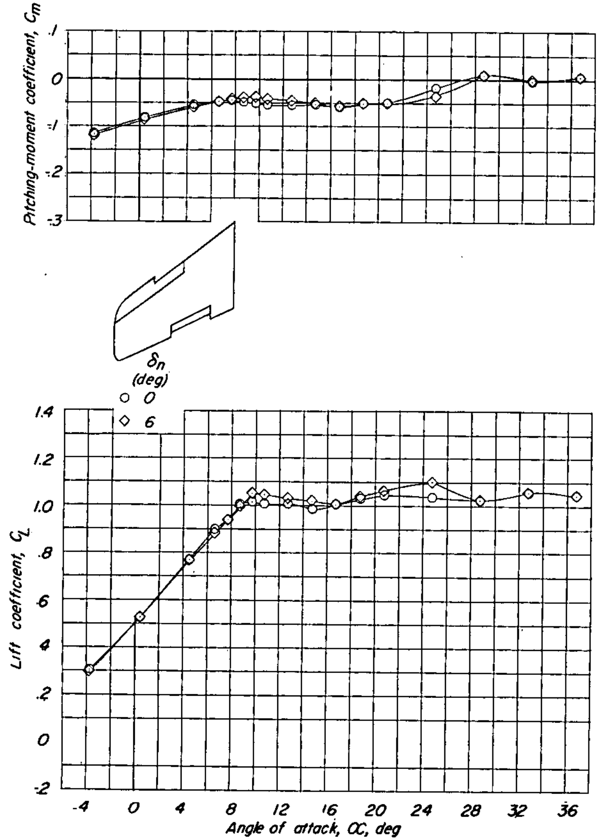


(c) Variation of C_D and L/D with α.
Fence A off.

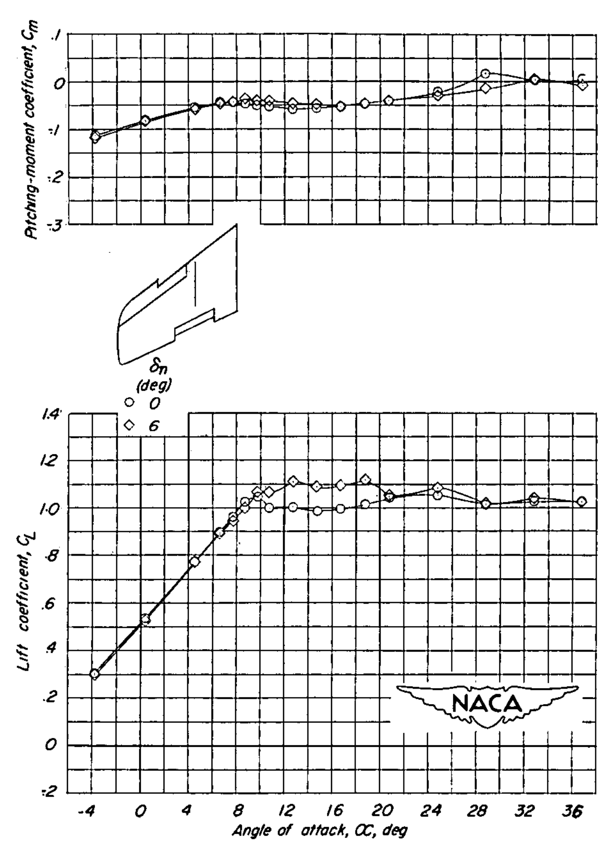


(d) Variation of C_D and L/D with α.
Fence A on.

Figure 8.- Concluded.

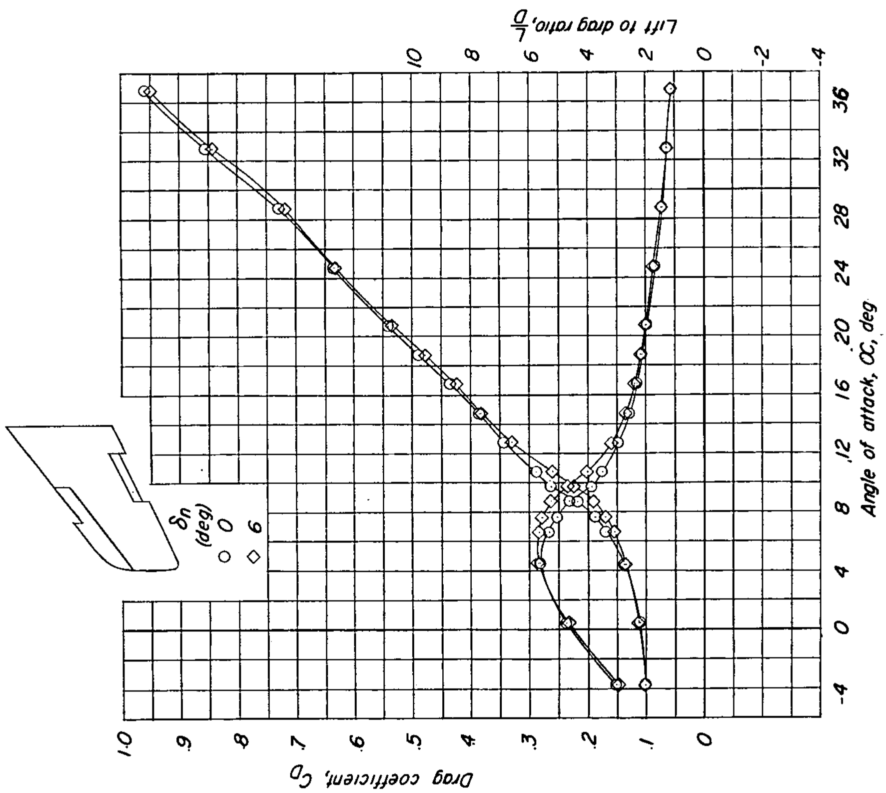


(a) Variation of C_m and C_L with α. Fence A off.

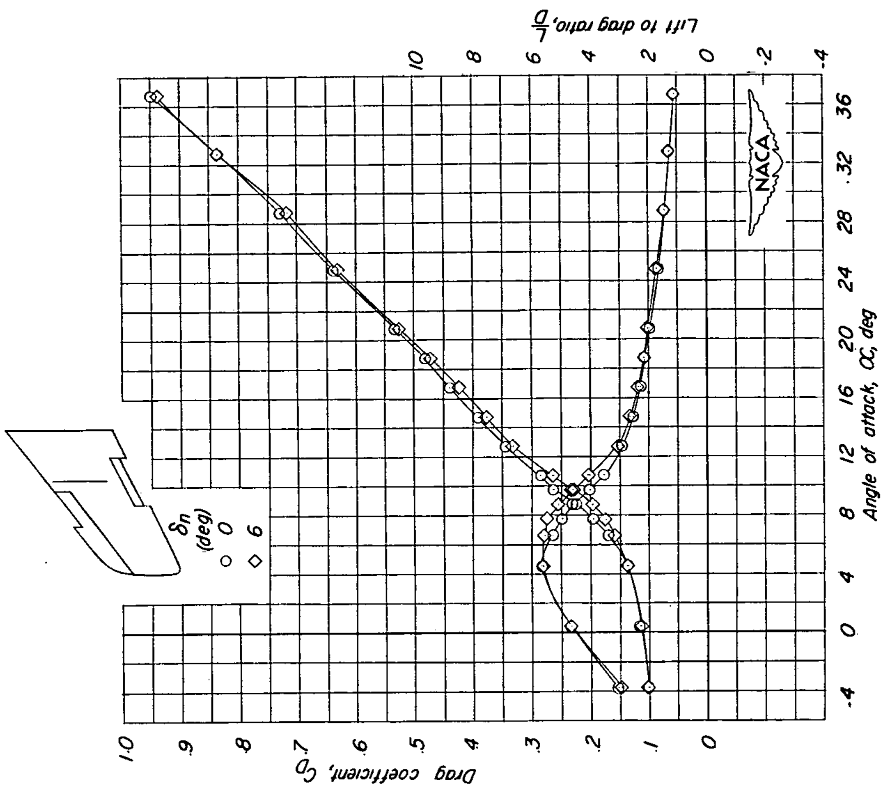


(b) Variation of C_m and C_L with α. Fence A on.

Figure 9.- Effects of droop of combined leading-edge flap and chord-extension on aerodynamic characteristics of an airplane model having a 35° swept-back wing. Horizontal tail off; $\delta_f = 0°$.

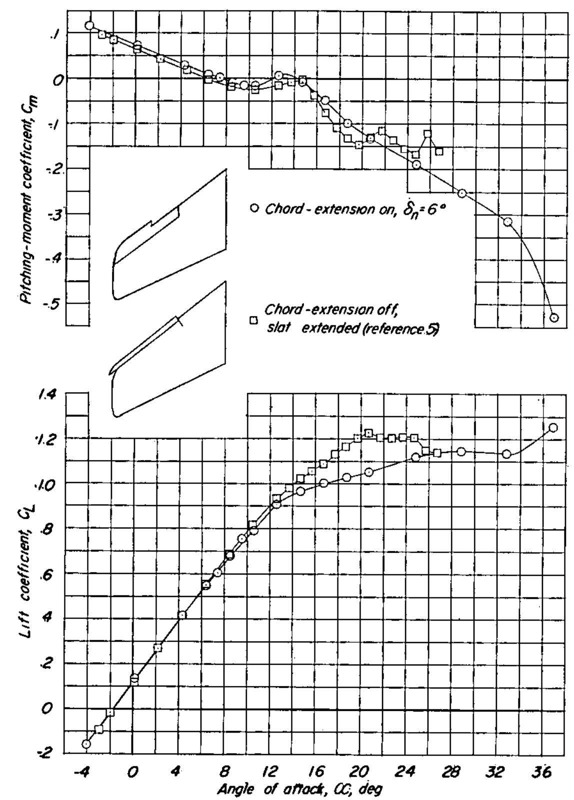


(c) Variation of C_D and L/D with α.
Fence A off.

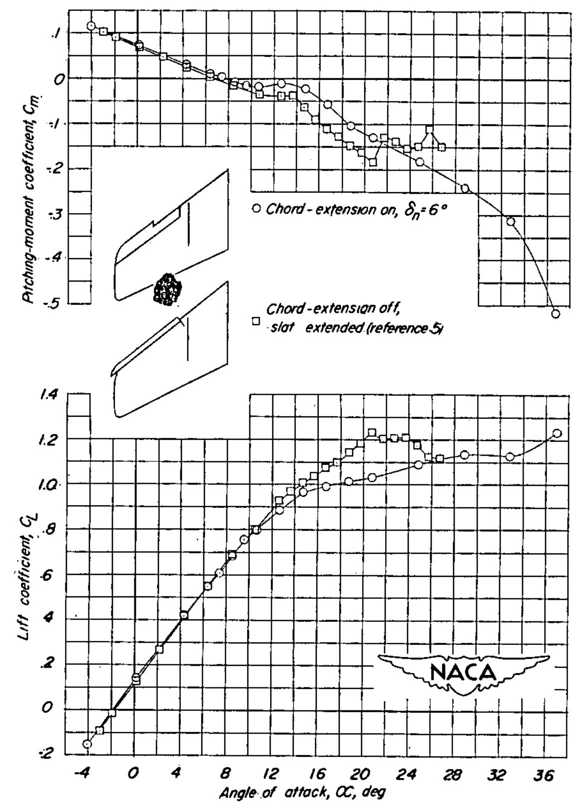


(d) Variation of C_D and L/D with α.
Fence A on.

Figure 9.- Concluded.

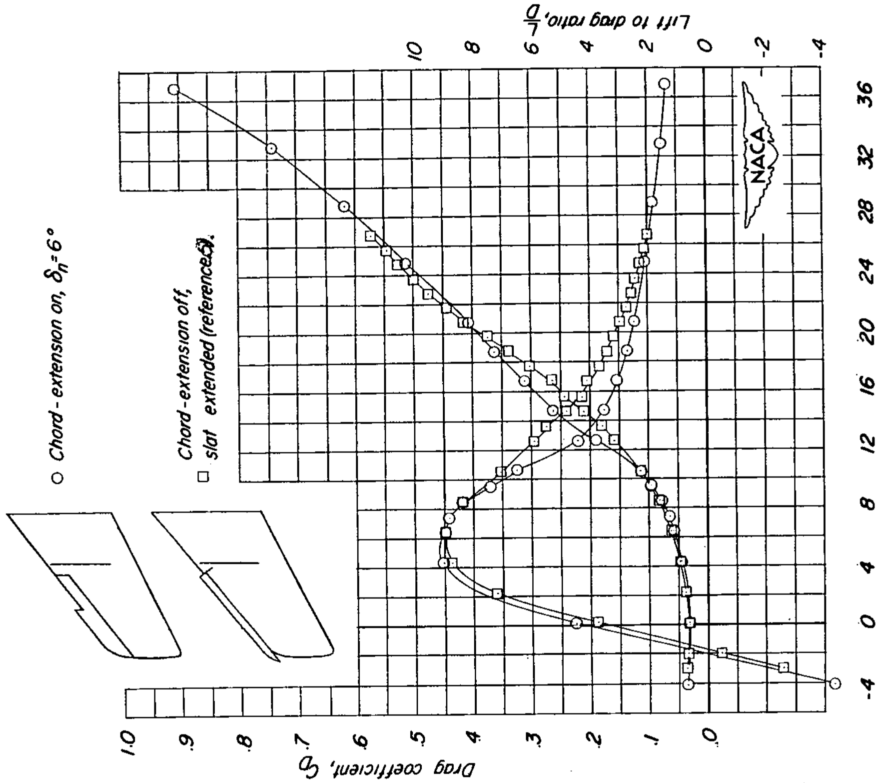


(a) Variation of C_m and C_L with α. Fence A off.

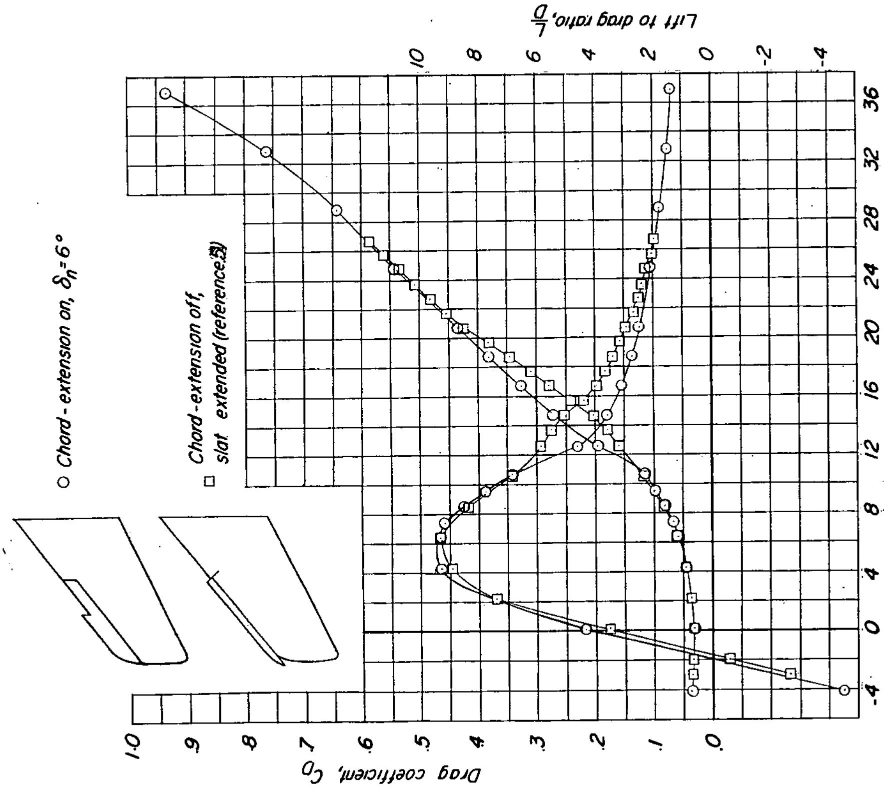


(b) Variation of C_m and C_L with α. Fence A on.

Figure 10.- Comparison of aerodynamic characteristics of an airplane model having a 35° sweptback wing with a drooped leading-edge flap and chord-extension combination or with slat extended and chord-extension off. Complete model; $\delta_f = 0°$.

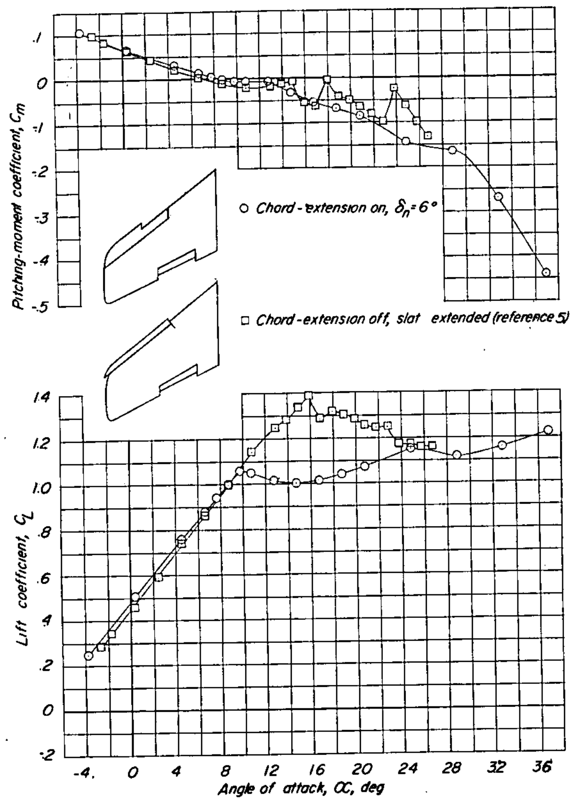


(d) Variation of C_D and L/D with α. Fence A on.

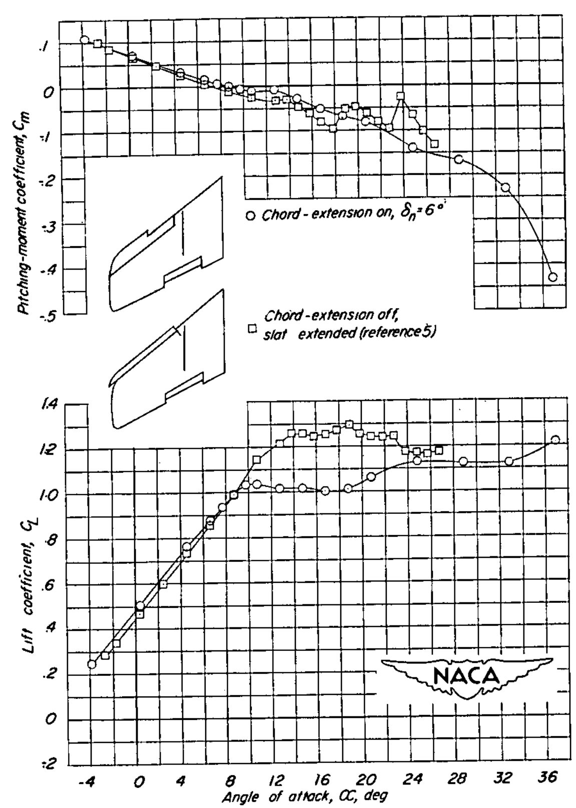


(c) Variation of C_D and L/D with α. Fence A off.

Figure 10.- Concluded.

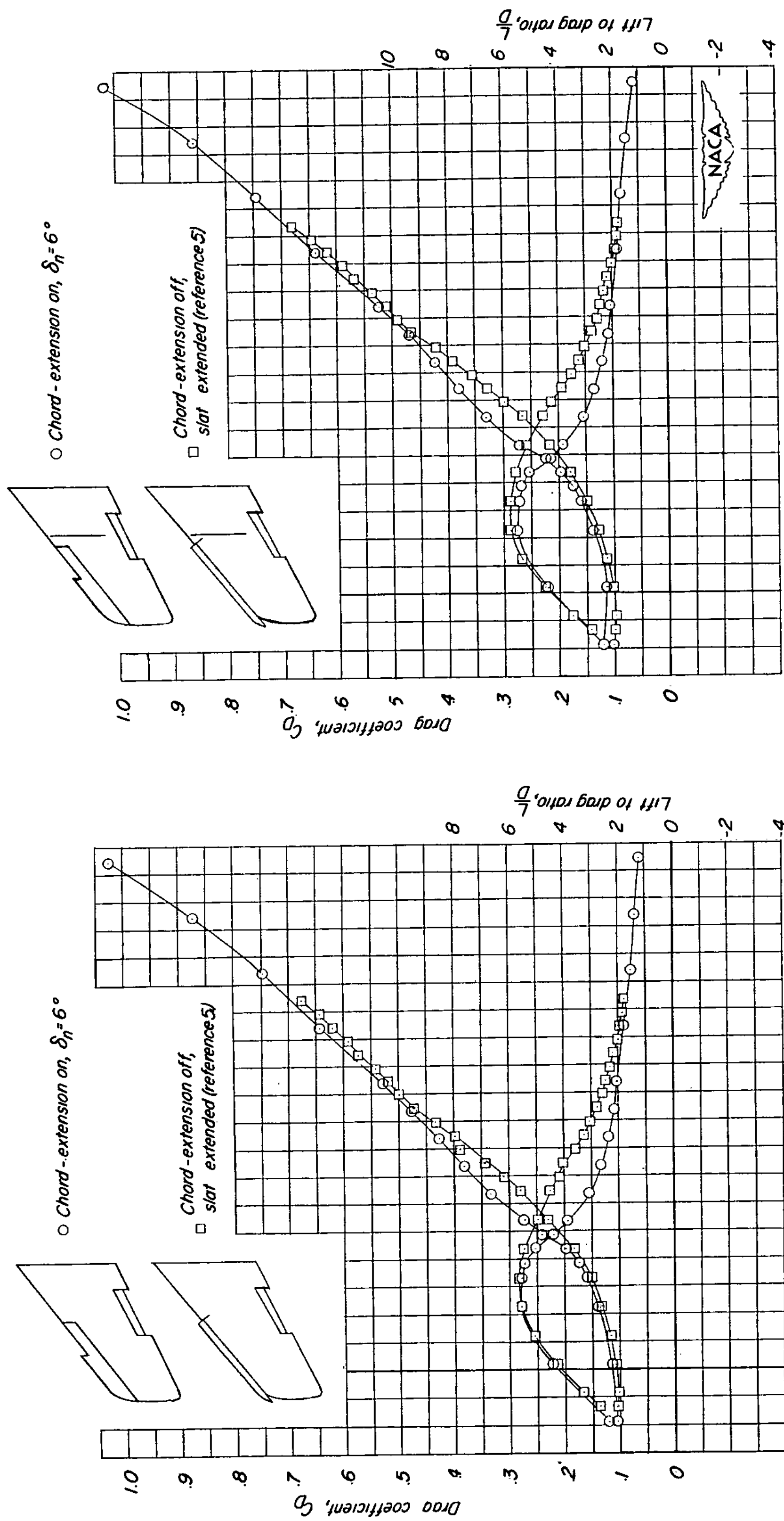


(a) Variation of C_m and C_L with α. Fence A off.



(b) Variation of C_m and C_L with α. Fence A on.

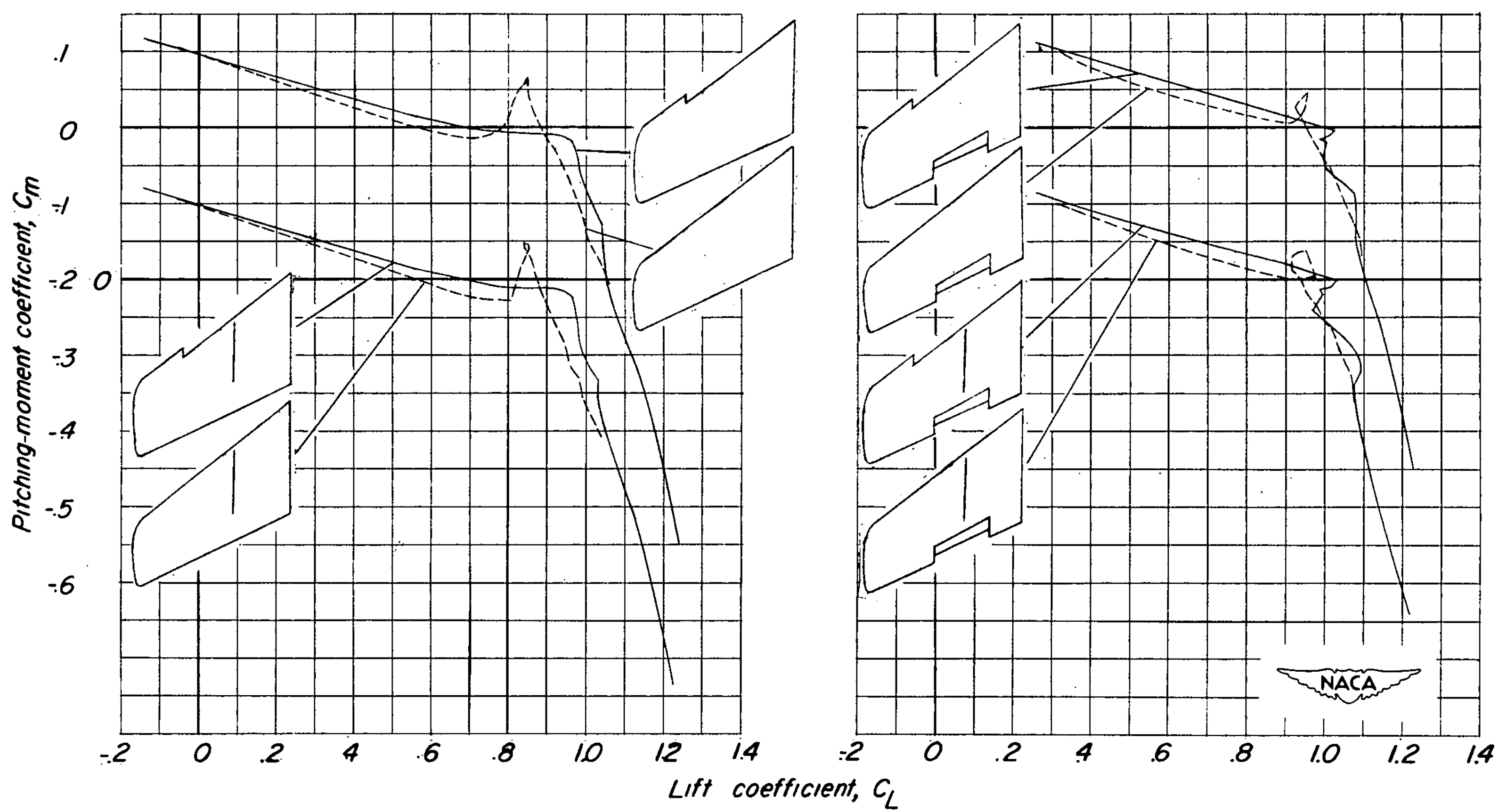
Figure 11.- Comparison of aerodynamic characteristics of an airplane model having a 35° sweptback wing with a drooped leading-edge flap and chord-extension combination or with slat extended and chord extension off. Complete model; $\delta_f = 50°$.



(c) Variation of C_D and L/D with α.
Fence A off.

(d) Variation of C_D and L/D with α.
Fence A on.

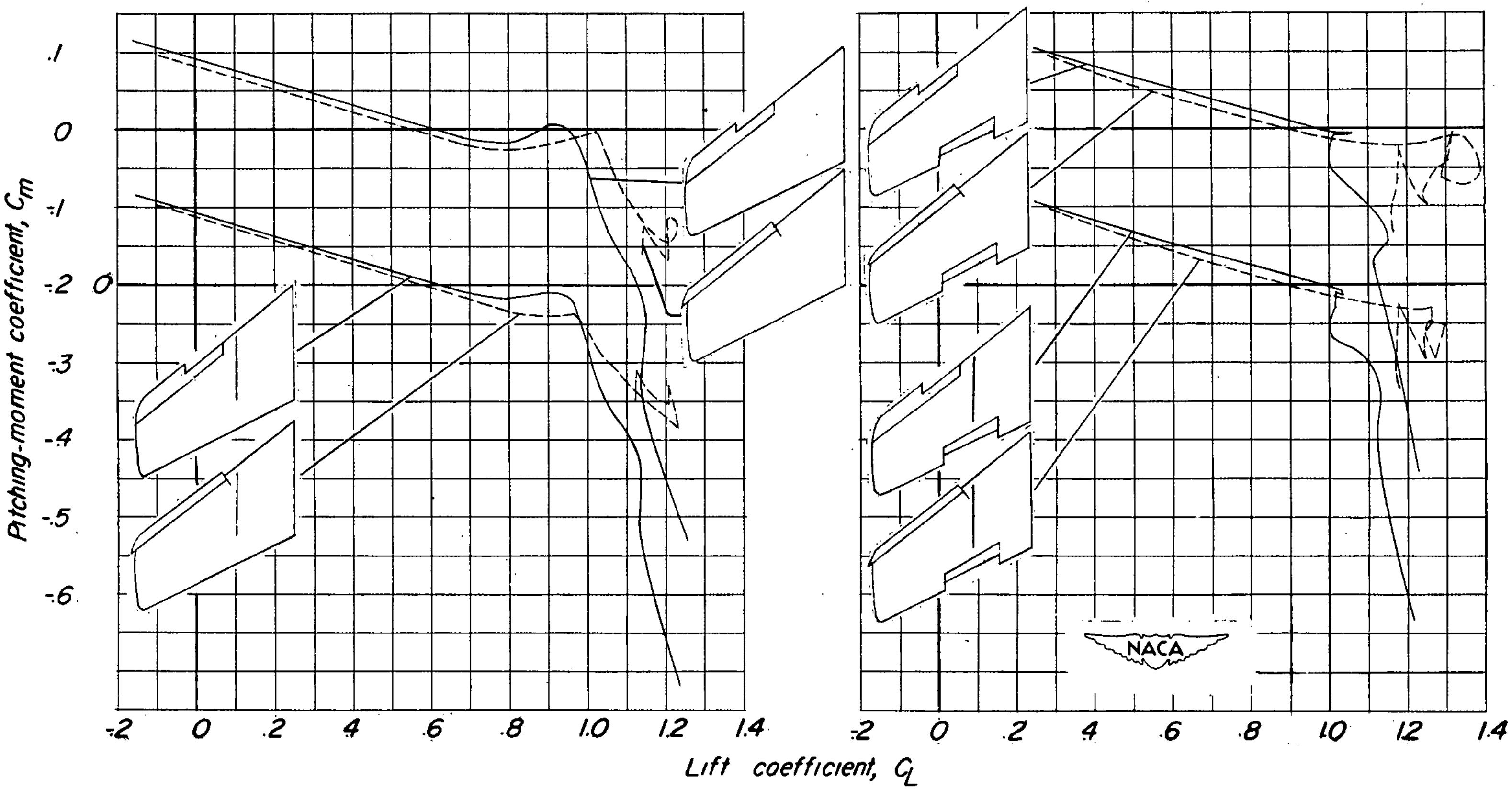
Figure 11.- Concluded.



(a) Effect of chord-extension on variation of C_m with C_L. $\delta_f = 0^{\circ}$; $\delta_n = 0^{\circ}$; fence A on and off.

(b) Effect of chord-extension on variation of C_m with C_L. $\delta_f = 50^{\circ}$; $\delta_n = 0^{\circ}$; fence A on and off.

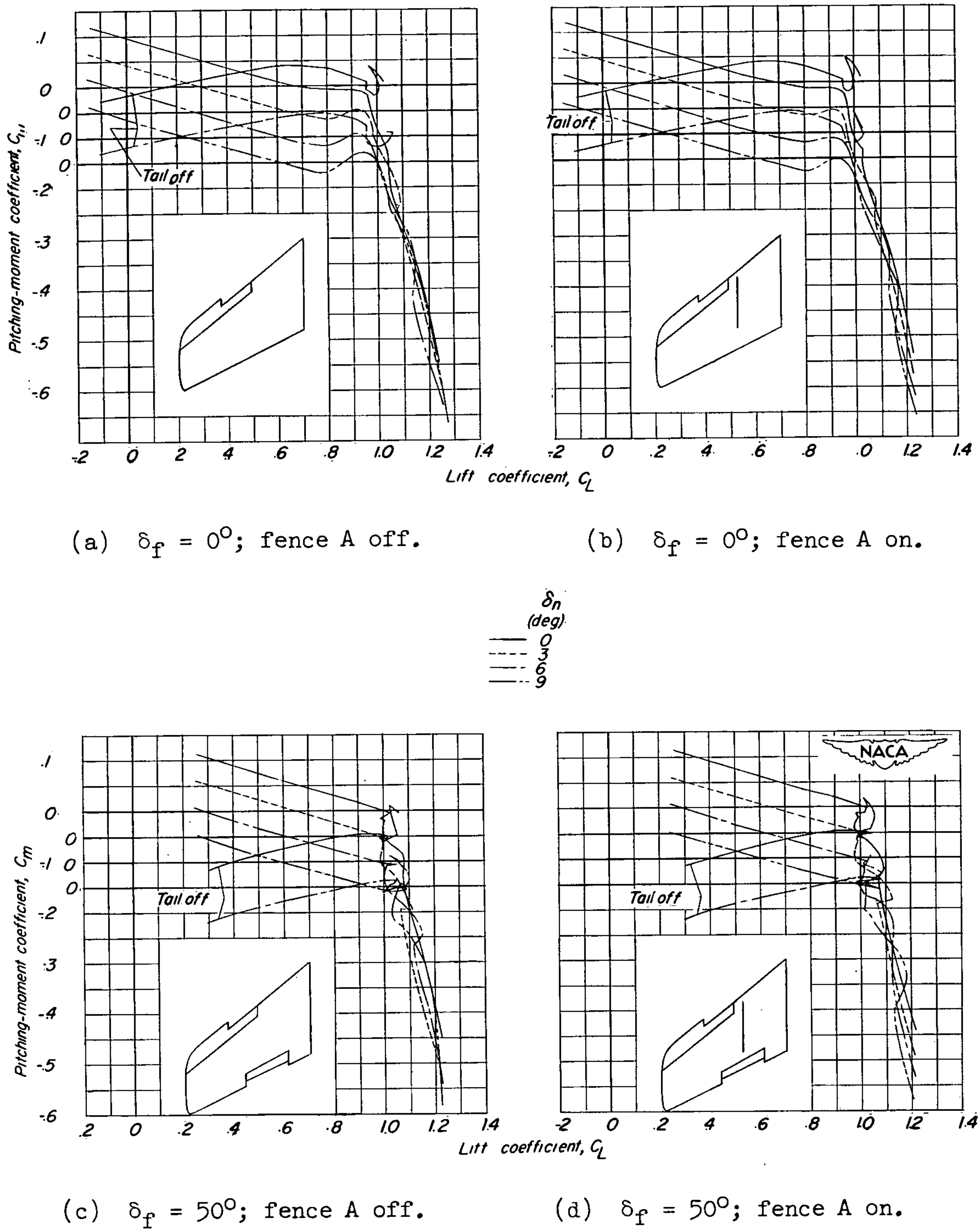
Figure 12.- Summary of effects of chord-extension, drooped leading-edge flap and chord-extension combination, and fence A on static longitudinal stability characteristics of an airplane model having a 35° sweptback wing with plain flaps neutral or deflected. (Data for chord-extension off from ref. 5.) Complete model.



(c) Comparison of the variation of C_m with C_L for a drooped leading-edge flap and chord-extension combination with a slat arrangement. $\delta_f = 0^\circ$; $\delta_n = 6^\circ$; fence A on and off.

(d) Comparison of the variation of C_m with C_L for a drooped leading-edge flap and chord-extension combination with a slat arrangement. $\delta_f = 50^\circ$; $\delta_n = 6^\circ$; fence A on and off.

Figure 12.- Concluded.



(a) $\delta_f = 0^\circ$; fence A off. (b) $\delta_f = 0^\circ$; fence A on.

(c) $\delta_f = 50^\circ$; fence A off. (d) $\delta_f = 50^\circ$; fence A on.

Figure 13.- Summary of effect of droop of combined leading-edge flap and chord-extension on longitudinal stability characteristics of an airplane model having a 35° sweptback wing. Horizontal tail on and off.